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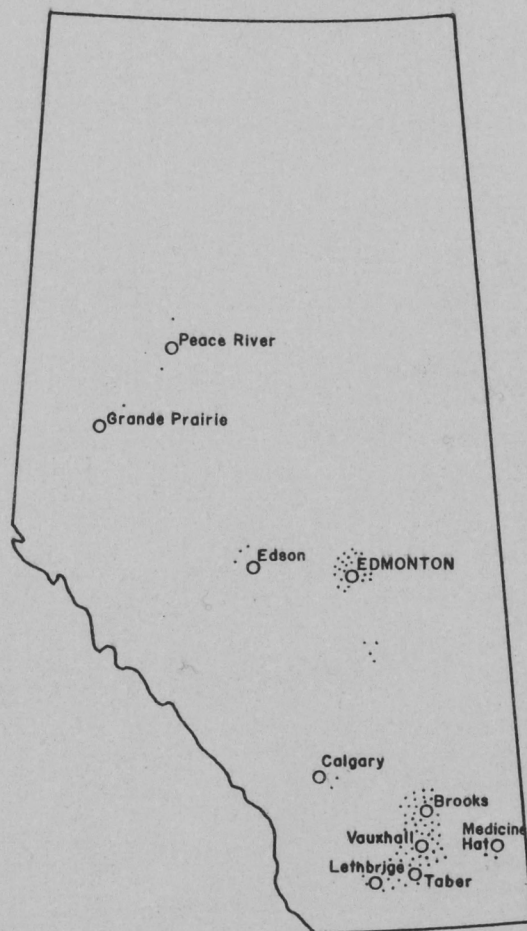
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EDMONTON, ALBERTA

CAPITAL INVESTMENTS, PRODUCTION COSTS AND YIELDS
OF COMMERCIAL POTATO PRODUCTION IN ALBERTA.

E.E.R. KING



Economics Branch,
CANADA DEPARTMENT OF AGRICULTURE

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Canada Department of Agriculture,
Edmonton, Alberta.

FOREWORD

In 1962 the Economics Branch carried out a study of the cost of producing commercial potatoes in Alberta. Preliminary reports on this study were published in the December 1962 and June 1963 issues of the Economic Annalist.

In this report, the objective is to supply detailed farm cost data and other information on the organization and on the management practices of potato farms in Alberta. This information should be particularly useful to actual and prospectus potato producers and to extension specialists and research workers.

We gratefully acknowledge the co-operation of the Field Crops Branch, Alberta Department of Agriculture and the many potato growers who provided valuable information on their farm business.

Knud Elgaard, Chief,
Alberta Regional Office, Edmonton,
Economics Branch, Canada Department of Agriculture.

Summary

(1) In 1962 there were about 14,300 acres of commercially produced potatoes in Alberta; two-thirds of this acreage was in Irrigation Districts, one-quarter in the Edmonton District and the remainder in other areas of the province. There were also 7,700 acres of non-commercial potatoes.

(2) The acreage in commercial potatoes more than doubled over the past ten years, and the trend has been to fewer and larger producing units.

(3) Capital requirements, solely for the potato enterprise, ranged from a few thousand dollars for the smallest producing units to almost one-quarter of a million dollars for the largest. This investment averaged \$750 - 800 per acre on the smaller units and \$400 - 500 on the larger units.

(4) The cost of producing potatoes in 1962 (excluding the labor and management inputs) ranged from about \$19 per ton on the smallest producing units in the Edmonton District to about \$14 per ton on the larger units in the Irrigation Districts.

(5) It takes about one cent per pound of potatoes (field run) to cover the cost of production, including hired labor but excluding operator's labor and management.

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Characteristics of Potato Production in Alberta

The production of commercial potatoes is concentrated in two areas, in the province of Alberta. The larger area encompasses the Irrigation Districts in the southern part of the province and the other is located within a 30 mile radius of Edmonton. Commercial acreage for the 1962-63 crop year was estimated at 9,413 acres in Irrigation Districts, 3,387 acres in the Edmonton area and about 1,500 acres in other areas within the province, giving a total of about 14,300 acres for the province as a whole. Commercial, plus non-commercial potato production, within the province, in 1962-63, is estimated at 22,000 acres.^{1/}

The Irrigation Districts range from 2,600 to 2,900 feet above sea level. The frost-free period is about 120 days and the annual precipitation 13 inches, of which nine inches fall during the growing period. The Edmonton area ranges from 2,100 to 2,300 feet above sea level, the frost-free period is 80-95 days and the annual precipitation 17.5 inches, of which 13 inches fall during the growing season. North of Calgary there are no major irrigation schemes, and growers generally rely on annual precipitation, although a few growers do supplement rainfall with sprinkler systems.

^{1/} We gratefully acknowledge the co-operation of Mr. J.B. Gurba, Supervisor of the Crop Protection and Pest Control Section, Field Crops Branch, Alberta Department of Agriculture. Mr. Gurba has supplied data which were most helpful to us in making estimates of acreages in commercial potatoes.

The estimate on total potato acreage is from the Quarterly Bulletin of Agricultural Statistics, Dominion Bureau of Statistics, Ottawa, January 1963, Table 2, page 39.

The number of commercial potato growers in 1962 was estimated at 362.^{2/} The trend in commercial production has been toward fewer growers and larger units. As part of this trend, for example, the number of farms inspected under the Alberta Pest Control Act was 601 in 1952 but only 342 in 1962; the acreage inspected increased from 6,286 acres to 13,121.^{3/} In 1962 about 48 per cent of the commercial growers operated units of nine acres or less, which accounted for five per cent of the total acreage in commercial potato production. On the other hand, about six per cent of the growers operated units of 150 acres or more, and they accounted for 38 per cent of the acreage.

Organization of the Study

Our survey was restricted to the Irrigation and to the Edmonton areas. A list of potato growers operating under the Alberta Pest Control Act served as a basis for selecting a sample of growers from each area. The growers were arrayed according to scale of operations and the two arrays were divided into multiples of 20 acres. A random sample was then drawn from each stratum in each of the two areas. The frequency distribution of growers, for each stratum, was known and the size of the sample selected from each stratum varied in accordance with the number of farms in that stratum. In strata with 50 or more farms, 20 per cent of the farms were selected and in strata in the neighborhood of five farms, 80 per cent were selected for the sample.

^{2/} This estimate includes operators of commercial enterprises outside of the Bacterial Ringrot control area.

^{3/} Annual Reports of the Department of Agriculture of the Province of Alberta, Queen's Printer, Edmonton.

The final sample included 46 growers in the Irrigation area and 35 in the Edmonton area. The 81 growers interviewed accounted for about 60 per cent of the 1962 commercial potato acreage in Alberta.

The information was collected in two calls. The first call was in July and the final call after harvest in November. Each call lasted from 1.5 to three hours. Our questionnaire was designed to obtain cost data for the potato enterprise itself and data on land use, and capital investment for over-all farming operations. The latter served as a basis for allocating general overhead costs between the potato enterprise and other farm enterprises.

For purposes of analysis, each of the two samples of farms were subdivided into four groups, according to scale of operations. The groupings were: 0 to 100 acres, 101 to 150, 151 to 350, and 351 to 600 acres. Fifty-four farms were in the first group, nine in the second, 13 in the third, and five in the fourth group. Records from seven of the 81 farms were either incomplete or definitely atypical with respect to the type of farm to be considered in the study. The average numbers or values used in our report are based on the following number of farms: in the Edmonton area, 23 farms in the first group, five in the second, and three in the third, and none in the fourth group,^{4/} in the Irrigation area 28 in the first group, four in the second, seven in the third group, and five in the fourth group. The selection of the four size groups was in accordance

^{4/} In 1962 only four potato farms in the Edmonton area had 151 or more acres planted to potatoes.

with distinct breaks in the relationship between the potato acreage and capital invested in specialized equipment and buildings, to operate that acreage. The arithmetic mean of the potato acreage did not in all cases correspond to the mid-point of the size group. The mean acreages of each sub-sort, or sample, are given in Table 1.

Land Use and General Farm Organization

Table 1 provides a summary description of land use and farm organization patterns. One may note the relative importance of rented land in over-all farming operations, and for the potato enterprise. The income producing capacity of this enterprise is reflected in its large contribution to operator's gross income, a contribution that tends to become larger and larger with an increase in the size of the enterprise. Aside from other crop enterprises, the cattle, swine and poultry enterprises have some importance in the over-all farming picture, especially on the smaller farms. Off-farm employment was an important source of income solely for the small-farm operators. In the Edmonton area, sources of off-farm income for farmers were paralleled by part-time farming work by urban residents seasonally or regularly employed in the city.

The number of operators per potato enterprise varied from one to four among the size groups. In our study, if a potato enterprise was operated and managed on a partnership basis, each partner was considered as an operator. This way of dealing with partnerships has an important bearing on the proper interpretation of the figures in our tables. For example, on the average, 3.3 operators share in the \$34,928 which represent the current value of all equipment used by the potato enterprise in the

101-150 acre size group in the Irrigation area (Table 2) as compared with 1.6 operators sharing in the \$15,495 worth of equipment in the 0-100 acre size group in the same area. (The importance of operator's labor and management in relation to costs of production is dealt with in another section of this report.)

Table 1.- Land Use and General Farm Organization. Averages per Farm, by Size Groups, Edmonton and Irrigation Areas, 1962

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
Total farm acreage	123	414	1,565	282	668	511	1,060
Owned	74	194	320	210	653	424	892
Rented	49	220	1,245	72	15	87	168
Total crop acreage	85	287	995	167	368	457	816
Potatoes	19	125	280	45	130	235	462
Grain and oilseed	48	124	530	57	127	109	143
Sugar beets	-	-	-	17	43	17	14
Summer fallow	17	37	185	31	42	70	155
Vegetables excl. potatoes	1	1	-	17	24	26	42
Total hay, pasture, farmstead, waste	38	127	570	115	302	54	244
Livestock numbers							
Horses	0.2	0.2	-	0.2	1.2	-	2.0
Cattle	4.7	9.2	16.0	25.1	98.0	8.4	128.2
Swine	43.0	2.4	-	9.1	-	0.3	58.0
Sheep	-	-	-	20.7	1.5	-	-
Poultry	83.0	2,020.0	-	248.3	138.7	18.6	10.0
Off-farm income ^{a/}	\$ 967.00	-	-	\$ 38.00	-	-	-
Potato enterprise							
Total acreage	19	125	280	45	130	235	462
Owned	9	79	95	24	115	155	298
Rented	10	46	185	21	15	80	164
Yield per acre, tons	5.32	6.04	6.69	8.24	8.45	9.45	9.51
Number of operators	1.0	2.2	2.0	1.6	3.3	1.4	2.0
	- per cent -			- per cent -			
Potato enterprise's share of operator's gross income	54	60	60	41	48	86	92

^{a/} Excludes family allowance and pensions.

Capital Investment in the Potato Enterprise

Table 2 supplies the current detailed information on equipment used by the potato enterprise. The tractors, trucks, cars, sprinklers, and cultivation equipment are used by many enterprises. It was impossible, and probably not necessary, to make a reliable apportionment of the value or cost of these different types of machines or equipment among different uses or enterprises.

Table 2.- Average Current Value, at Trade-in-prices, of Capital Investment in Equipment per Potato Farm. Averages by Size Groups, Edmonton and Irrigation Areas, 1962

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
	- dollars -			- dollars -			
Tractors	1,044	3,210	11,625	3,448	7,936	11,113	25,960
Trucks	646	3,680	4,800	2,855	5,787	8,771	15,148
Cars	520	1,740	1,775	1,550	2,512	2,600	3,680
Sprinklers ^{a/}	113	1,300	-	1,910	4,575	7,343	10,220
Pre-harvest equipment ^{b/}	794	2,057	8,665	1,561	2,835	4,102	10,328
Potato harvesting equipment ^{c/}	714	4,142	5,990	1,593	5,041	9,603	19,025
Post harvest potato equipment ^{d/}	251	2,130	4,092	474	1,117	2,005	2,944
Present value of equipment used for potato enterprise	4,082	18,259	36,947	13,391	29,803	45,637	87,295
Grain, livestock hay, equipment	978	2,050	10,225	2,104	5,125	1,100	3,690
Present value of all equipment	5,060	20,309	47,172	15,495	34,928	46,637	90,985

a/ In the Edmonton area only 4 farms had sprinkler systems, which accounts for the comparatively low average values the group. The present value of the systems considered individually was considerably more, ranging from \$800 to \$4,000.

b/ Pre-harvest equipment includes: seed cutters, seed treaters, potato planters, spreaders, sprayers and all tillage equipment and irrigation equipment other than sprinklers.

c/ Potato harvesting equipment includes: vine-killing equipment, mechanical diggers and harvestors, trailers and wagons, but does not include trucks nor potato boxes (the latter included with trucks).

d/ Post-harvest potato equipment includes: pilers and conveyors, graders, washers, driers, scales, sprouters, stoves, staplers, etc.

The current value of machines and equipment was established on the basis of prices the operator could get if he traded these for new equipment. The assumption was that each farm is a going concern and any piece of equipment

dealt off would have been replaced by a newer and generally superior piece. The current value of the equipment (Table 2) takes account of the depreciation of new and used equipment.

Table 2 represents the amount of money tied up in equipment used for the potato enterprise and over-all farming operations. To the person already operating a farm the introduction of a small potato enterprise does not constitute a major investment. The operator of such an enterprise can get by with very little specialized equipment; a potato planter, digger, grading table and storage space is about all that is required. Large-scale operations present quite a different picture with regard to the size of investment required in specialized equipment and buildings. As shown in Table 2, the largest enterprises in the Irrigation Area have over \$30,000 invested in highly specialized equipment and \$18,000 more in potato storage. As one would expect, there is a direct relationship between the volume of potatoes handled by an operator and the size of investment required to handle that volume.

When comparing the investment in equipment between the Edmonton area and the Irrigation area, one notes that for comparable size groups the Irrigation area has about \$10,000 more invested in equipment used for the potato enterprise than has the Edmonton area. Some of the difference is accounted for by the investment in sprinkler systems and specialized irrigation equipment. The additional operations of one or two irrigations sandwiched in between cultivations during the growing season bring to some extent, a greater need for capacity in equipment in irrigated than in other areas. Also, higher yields per acre undoubtedly account for a larger investment in trucks and harvesting equipment in irrigated areas.

Table 3.- Average Expenditure, per Potato Farm, for Addition to Equipment Used in Potato Production. Averages by Size Groups, Edmonton and Irrigation Areas, 1962²

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
The average expenditure, per farm, by adding <u>new</u> equipment	5,037	16,213	45,176	18,286	34,281	57,468	108,099
The average expenditure, per farm, by adding <u>second hand</u> equipment	3,162	15,425	8,169	4,839	14,820	6,060	10,630
	- per cent -			- per cent -			
Percentage of total equipment expenditure, on new equipment	61	51	85	79	70	90	91

a/ No definite statement can be made here in regard to the period of time involved in process of accumulating the existing complement of equipment.

The accumulation of equipment on potato farms has generally taken place not only by the purchase of new items, but also by the purchase of second-hand items. As one may expect, the purchase of second-hand items has been a relatively important feature in the accumulation of equipment on the small and medium-size farms. Table 3 shows the average outlay per farm for items purchased new and for items purchased second-hand. These values indicate the average outlay that the respective farms have incurred over time in the process of accumulating their present complement of equipment. The values represent the amount that the equipment has cost the operator and does not take account of depreciation, as in Table 2. The average expenditure on new equipment gives a rough indication of the investment needed if a person were to enter the business and intended to purchase his equipment new.

In viewing the industry as a whole, there is evidence that the used-machinery market plays an important role in the transfer of used machinery from the large to the small farms. It may be noted from Table 3

that 85 to 90 per cent of the total expenditure on equipment by the large farms is on new equipment: this compares with 51 to 79 per cent for the small farms.

Table 4.- Present Value of Buildings Used for the Potato Enterprise, per Potato Farm, Averages by Size Groups, Edmonton and Irrigation Areas, 1962

Type of Building	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100	101-150	151-350	0-100	101-150	151-350	351-600
	acres	acres	acres	acres	acres	acres	acres
	- dollars -			- dollars -			
Potato storage	935	2,272	13,719	1,814	7,323	10,491	18,286
Implement	53	180	1,787	185	250	884	505
Labor accommodation	208	646	3,270	397	800	3,389	7,239
Present value of buildings used for potato enterprise	1,196	3,098	18,776	2,396	8,373	14,764	26,030

Table 4 shows the present value of buildings used for the potato enterprise. As in the case of certain equipment the use of implement sheds and accommodation for labor is shared among the other enterprises on the farms, but the full current value is shown in the table. Again, as in the case of equipment, there is a close and direct relationship between the capital invested in potato storage buildings and the volume of potatoes handled. The large enterprises have very elaborate storage facilities. On some of these farms the initial investment in storage buildings is over \$22,000 (Table 5).

The most common type of storage building, for all size groups, was a pole and straw structure with a sod layer on top. Storage capacity was in the neighborhood of 400 tons on the small farms and close to 5,000 tons on the large farms.

Very few potato farms had elaborate implement sheds. Many operators utilized a portion of their storage buildings as cover for some equipment.

Special buildings, for the accommodation of hired labor were provided on farms in all size groups, but especially on the larger farms. In some instances six or seven small dwellings were erected in the operator's yard. The dwellings of the operator or of the partners were not included in the values shown in Table 4. The replacement values of the operators' dwellings and of buildings used for other enterprises are shown in Table 5.

Table 5.- Replacement Value of Buildings Used for the Potato and Other Enterprises, and of the Operator's Dwelling, per Potato Farm. Averages by Size Groups, Edmonton and Irrigation Areas, 1962^{a/}

Type of Building	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100	101-150	151-350	0-100	101-150	151-350	351-600
	acres	acres	acres	acres	acres	acres	acres
	- dollars -			- dollars -			
Potato storage	1,194	3,228	15,750	2,373	10,000	12,178	22,080
Implement	180	300	2,250	253	500	1,093	980
Labor accommodation	239	700	4,250	1,012	1,700	5,628	10,620
Replacement value of buildings used for potato enterprise	1,613	4,228	22,250	3,638	12,200	18,899	33,680
Buildings used for other enterprises	1,420	7,690	10,850	1,818	3,250	950	7,000
Operator's dwelling ^{b/}	7,521	11,560	26,000	5,166	14,875	8,000	19,200

^{a/} Valued at 1962 prices.

^{b/} For the average numbers of operators per farm in each size group, see Table 1, Page 5.

A summary of the capital requirements is shown in Table 6. In addition to the present value of equipment and buildings the average value of land used by the potato enterprise and the average value of working capital have been included. Total capital requirements represent an approximation of the value of inputs required to operate potato enterprises. The manner in which the operator has control over these inputs is quite

irrelevant. That is, it does not matter whether the operator owns, rent, or borrows the specific input.

Table 6.- Summary of Average Capital Requirement, per Farm: Equipment, Buildings, Land, and Working Capital for the Potato Enterprise. Averages by Size Groups, Edmonton and Irrigation Areas, 1962

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
	- dollars -			- dollars -			
Present value of equipment used for potato enterprise ^{a/}	4,082	18,259	36,947	13,391	29,803	45,537	87,295
Present value of buildings used for potato enterprise ^{b/}	1,196	3,098	18,776	2,396	8,373	14,764	26,030
Average value of land used for potato enterprise ^{c/}	8,577	26,720	99,500	19,225	42,205	52,520	93,794
Average value of working capital invested in potato enterprise ^{d/}	448	3,085	8,108	1,380	3,998	7,301	15,828
Total capital requirements ^{e/}	14,303	53,162	163,331	36,392	84,379	120,122	222,947

^{a/} & ^{b/} Sources: Tables 2 and 4 respectively.

^{c/} The values assigned to cultivated land in the Edmonton and Irrigation areas were \$100 per acre, and \$115 per acre, respectively. Since it is a good practice to incorporate a crop rotation into the production of potatoes the average number of cultivated acres (owned and rented per farm), within each size group, served as a basis in establishing the acreage used for the potato enterprise. See Table 1.

^{d/} Working capital is to be understood as the average investment in variable inputs from the moment they are tied up in the production process until the time of receipts for the product. Seed fertilizer and labor on seed cutting are inputs which were estimated to be tied up for a period of 6 months before sale of the product could take place. On the other hand, containers and labor on grading are inputs which are tied up for a very short period, say one month.

^{e/} Total capital requirements do not include the investment in the operator's or partner's dwellings, nor the investment in buildings and equipment used solely for other enterprises.

The value of land was assigned at \$100 per cultivated acre in the Edmonton area and \$115 per cultivated acre in the Irrigation area.^{5/} Considerable variation was noted in the market values of land from one farm to another. This was particularly true in the Edmonton area where the value of land was closely associated with a speculative value in terms of urban use. The values used in the table were selected somewhat arbitrarily and were intended to reflect the value of land used for agricultural purposes. The acreage required for the potato enterprise was

^{5/} These are bareland values, excluding the value of buildings.

assumed to be equal to the acreages actually cultivated, owned and rented, within each size group. This would provide room for a crop rotation in the course of over-all farming operations.

Working capital is another production input. From the time seed is purchased until the harvested potatoes are sold, money is tied up in the production process. The average value of working capital (Table 6) was calculated from the average investment in variable inputs (e. g. seed, hired labor, fertilizer, feed sprays, etc.) from the moment they are tied up in the production process until the time of receipts for the product. For some inputs the investment in working capital represents an imputed investment. This is generally the case for potato seed; the operator carries the seed over from the previous crop year and no cash changes hands. Nevertheless, the operator has the alternative of selling his product and purchasing new seed when required. For a new potato producer the money outlay for new seed is, of course, a direct investment.

Production Costs

Tables 7 and 8 show the average cost of producing potatoes, by size group and by area. Table 7 shows the average cost per acre, of producing potatoes, and Table 8 shows the average cost per ton, of producing potatoes. In both tables the costs have been broken down into variable and fixed costs. Variable costs are defined as costs that may be altered during the course of the production period, and are analogous to the operating costs incurred during the crop year. Fixed costs are incurred during one period and spread succeeding periods.

Table 7.- Average Costs per Acre, per Farm, of Producing Potatoes. Averages by Size Groups, Edmonton and Irrigation Areas, 1962^a

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
	- dollars -			- dollars -			
Variable costs per acre							
Fuels and lubricants	5.83	4.82	3.50	8.70	7.09	8.07	8.86
Annual repairs, equipment	11.50	7.94	8.44	12.35	16.75	11.92	13.19
License and insurance equipment	1.84	0.92	1.02	1.16	1.52	1.16	1.20
Building repairs and insurance	1.20	0.95	1.86	3.62	1.69	1.00	2.46
Custom work hired	2.45	0.47	1.33	1.01	-	0.47	1.07
Hired labor	22.73	23.71	41.03	33.76	21.75	39.03	44.85
Seed	19.44	23.40	22.15	22.64	21.25	22.12	23.87
Fertilizer	4.63	7.22	8.88	6.81	13.75	10.19	9.69
Sprays	2.00	1.03	0.83	1.93	2.12	1.48	3.06
Containers	7.85	9.05	17.16	19.86	15.74	18.61	14.39
Electric power and telephone	0.97	1.37	1.77	1.59	2.22	1.49	2.12
Other	0.37	0.46	0.57	1.39	1.06	1.70	2.72
Interest on working capital	1.65	1.73	2.03	2.15	2.15	2.17	2.39
Total variable costs	82.46	83.07	110.57	116.97	106.99	119.41	129.86
Fixed costs per acre ^{b/}							
Depreciation							
Equipment	21.91	17.42	16.73	22.73	19.74	24.11	25.29
Buildings	3.87	1.40	2.70	3.54	4.02	2.82	2.91
Interest on investment							
Equipment	7.34	5.79	5.60	10.08	6.68	8.29	8.60
Buildings	2.76	0.68	3.29	2.06	2.85	2.33	2.89
Owned land	2.37	3.16	1.70	3.07	5.09	3.79	3.71
Land taxes plus land rent	9.33	8.87	6.48	10.08	5.59	7.23	5.65
Water rate	-	-	-	2.13	2.20	2.07	2.08
Total fixed costs	47.58	37.32	36.50	53.69	46.17	50.64	51.13
Total variable costs	82.46	83.07	110.57	116.97	106.99	119.41	129.86
Total costs per acre (excluding return to operator labor and management)	130.04	120.39	147.07	170.66	153.16	170.05	180.99
Average number of operators per farm ^{c/}	(1.0)	(2.2)	(2.0)	(1.6)	(3.3)	(1.4)	(2.0)

^{a/} The costs shown in this table differ from those shown in Tables 1 and 2, pages 59 and 60 of The Economic Annalist, June 1963, in the following respects. The interest on working capital has been recalculated from a base of one half of the various costs, assuming all inputs were tied up for 6 months, to a base in which inputs were considered individually in calculating the period in which they were tied up in the production process, see footnote d, Table 6, Page 11. The interest on owned land was omitted from the afore mentioned tables, but included in the present table. For the values of land see footnote c, Table 5, Page 10.

^{b/} The fixed costs shown here represent the share borne by the potato enterprise in the over-all farming operations.

^{c/} Note that the average number of operators is per farm whereas total costs (excluding return to operator labor and management) is per acre.

As part of our field work, our enumerators asked the farm operators for their views on the importance of each piece of machinery and equipment and of each building, to the potato enterprise. We added this information to that on farm organization in our calculation of that share of joint and other fixed costs that goes to the potato enterprise. Obviously, fixed costs for potato storage buildings and specialized potato equipment were all charged to

Table 8.- Average Costs per Ton, per Farm, of Producing Potatoes. Averages by Size Groups, Edmonton and Irrigation Areas, 1962^a

	Size of Potato Enterprise Edmonton Area			Size of Potato Enterprise Irrigation Area			
	0-100 acres	101-150 acres	151-350 acres	0-100 acres	101-150 acres	151-350 acres	351-600 acres
Average yield, tons per acre	5.32	6.04	6.69	8.24	8.45	9.45	9.51
	- in dollars -			- in dollars -			
Variable costs per ton							
Fuels and lubricants	1.10	0.80	0.52	1.06	0.84	0.85	0.93
Annual repairs, equipment	2.16	1.31	1.26	1.50	1.98	1.26	1.39
License and insurance, equipment	0.34	0.15	0.15	0.14	0.18	0.12	0.13
Building repairs and insurance	0.22	0.16	0.28	0.44	0.18	0.11	0.26
Custom work hired	0.46	0.08	0.20	0.12	-	0.05	0.11
Hired labor	4.27	3.92	6.13	4.10	2.57	4.13	4.72
Seed	3.66	3.87	3.31	2.75	2.52	2.34	2.51
Fertilizer	0.87	1.20	1.33	0.82	1.63	1.08	1.02
Sprays	0.38	0.17	0.13	0.23	0.25	0.16	0.32
Containers	1.48	1.50	2.57	2.41	1.86	1.97	1.51
Electric power and telephone	0.18	0.23	0.26	0.19	0.26	0.16	0.22
Other	0.07	0.08	0.08	0.17	0.13	0.18	0.29
Interest on working capital	0.31	0.29	0.30	0.26	0.25	0.23	0.25
Total variable costs	15.50	13.76	16.52	14.19	12.65	12.64	13.66
Fixed costs per ton ^{b/}							
Depreciation							
Equipment	4.12	2.89	2.50	2.76	2.34	2.55	2.66
Buildings	0.73	0.23	0.40	0.43	0.48	0.30	0.31
Interest on investment							
Equipment	1.38	0.96	0.84	1.22	0.79	0.88	0.90
Buildings	0.52	0.11	0.49	0.25	0.34	0.25	0.30
Owned land	0.44	0.52	0.25	0.38	0.60	0.40	0.39
Land taxes plus land rent	1.75	1.47	0.97	1.22	0.66	0.76	0.59
Water rate	-	-	-	0.26	0.26	0.22	0.22
Total fixed costs	8.94	6.18	5.45	6.51	5.47	5.36	5.37
Total variable costs	15.50	13.76	16.52	14.19	12.65	12.64	13.66
Total costs per ton (excluding return to operator's labor and management)	24.44	19.94	21.97	20.70	18.12	18.00	19.03
Average number of operators per farm	(1.0)	(2.2)	(2.0)	(1.6)	(3.3)	(1.4)	(2.0)

^{a/} The costs shown in this Table differ from those costs shown in Tables 3 and 4, pages 61 and 62, of The Economic Annalist, June 1963. For an explanation of the difference see footnote a, Table 7, Page 13.

^{b/} The fixed costs shown here represent the share borne by the potato enterprise.

the potato enterprise. On the other hand, about 60 per cent of the fixed costs, for power and for some cultivation equipment, was allotted to the potato enterprise.

We have constructed our tables in such a way as to make them self-explanatory but, nevertheless, a few words about the analysis of these data may not be superfluous.

With regard to fuel consumption, for example, large enterprises enjoy economies of scale through the use of larger tractors that consume lower-priced fuels. The main reason for the higher cost of fuels and lubricants in the Irrigation area was attributed to the general use of petroleum-powered sprinklers; in addition, all grades of fuel were generally two cents a gallon higher than in the Edmonton area. The figure for custom work is a net figure inasmuch as custom work performed has been subtracted. Machinery rentals were included under custom work along with hired trucking, hired spraying and etc. Hired labor refers only to that labor which was hired and does not include operator's or family labor. In cases where a partnership existed the partners were considered as joint operators and their work was not included as a cost item. The seed item included both purchased seed and homegrown seed, the latter valued at the operator's estimate of sale value. Fertilizer refers primarily to the cost of commercial fertilizer. Barnyard manure was used by only a few enterprises. The cost of commercial fertilizer was from one to eight dollars a ton lower in the Irrigation than in the Edmonton area. Disinfectants and insect sprays were not used in large quantities; the smallest enterprises usually purchased these items in lump sums in excess of actual requirements. Burlap sacks were generally used for containers, although a number of growers sold their potatoes in consumer packs. In a few cases potatoes were sold in the bulk form. Cost items included under "Other" are fuel oil for heating, twine, rubber boots, crop insurance and other miscellaneous items. Interest on working capital was estimated at seven per cent of the average value of working capital (Table 6). The diminishing-balance method was used for computing depreciation charges on equipment, and the

straight-line method for buildings. Interest on investment was calculated at five per cent of the current value of buildings, equipment and owned land. Land taxes plus land rent were apportioned to the potato enterprise. The varying costs, of this item per acre, among the different size groups reflect differences in land tenure patterns (Table 1). Water rate was an additional cost item to the growers in the Irrigation area, where the cost of irrigation water varied from district to district and ranging from \$1.50 to \$3.50 an acre.

One must note that, in Tables 7 and 8, returns to operator's labor and management were not included as costs to the potato enterprise. The survey did not yield enough information to evaluate this particular item, especially in the case of the more complex farms. Had operator's labor and management been evaluated it would have been treated as a fixed cost, even though it does serve to replace hired labor. The substitution of operator labor for hired labor is particularly evident in the 101-150 acre size group of the Irrigation area where, with 3.3 operators per farm, the average cost of hired labor was only \$21.75 an acre. In the 0-100 acre size group, the average number of operators was 1.6 per farm and the average cost of hired labor \$33.76 an acre.

Economies of scale is an economic term which implies a decrease in output cost, per unit, as a plant, firm, or industry increases in size or volume of business. In agriculture, especially with types of farms where field crops predominate, acreage is usually the main determinant of scale or volume of business.

Economies of scale, however, do not mean that an entrepreneur must be looking for an ever-expanding size of business. There are

diseconomies as well as economies of scale and there is usually a point on the rising scale or volume of business where economies tend to give way to diseconomies.

A scrutiny of the data in Table 8 will show the impact of scale on returns and will also suggest that--considering average total costs per ton--the most economic size is within the range of 101-150 acres in the Edmonton area and of 151-350 acres in the Irrigation area. However, had we made an allowance for the cost of the operator's labor and management, in our calculations, the comparative cost situation, among size groups, might have been altered.

Yields

The net returns to the operator, for his labor and management, depend on a number of factors, including costs of production, yields and prices. The average cost per acre and the average cost per ton, given the specified yields, have been examined in a previous section. Crop yields vary from area to area, with varieties, with fertility and cultural practices, and with the time at which the crop is harvested. Prices received by the grower not only vary with the grade of the product but also from year to year, depending on the over-all supply and demand situation, and may also vary within any crop year according to the month during which the potatoes are sold. This is particularly evident in comparisons of the prices of early new potatoes with the prices received for the main crop. As an example, the prices received by operators for their first deliveries of new potatoes have frequently ranged between \$80 and \$90 a ton whereas deliveries of the main crop later on in the year have brought as low as \$20

to \$30 a ton. We have not calculated net returns to the operator from the potato enterprise. However, our report does contain enough information for the interested reader to draw up budgets for the enterprise, provided he be willing to estimate expected prices.

Table 9 shows the average yield per acre of potatoes in the two areas, by variety and by time of harvest. The average yield as shown in Tables 9 and 10 and the two tables in the appendices, pertains to the field run yield of potatoes and does not allow for shrink nor culls. It was observed that about 70 per cent of the field run potatoes graded out as marketable table stock. In several cases the culled small potatoes were saved for the next year's seed.

Table 9.- Average Yield per Acre, by Variety of Potatoes and Time of Harvest, Edmonton and Irrigation Areas, 1962^{2/}

Area and Variety	Time of Harvest	
	July - August	September - November
	- tons per acre -	
Edmonton Area:		
Warba	4.5	-
Netted Gem	-	6.2
Irrigation Area:		
Warba	6.6	7.6
Cobbler	6.6	6.7
Norland	9.8	8.9
Pontiac	10.6	11.2
Netted Gem	5.4	9.7

^{a/} The yields shown in this table have been weighted by the acreages. For the acreages and field numbers contained in each sample, weighted and simple averages, and standard deviation see Tables A and B of the Appendix. All yields are in terms of field-run production.

As a rule, growers practiced a crop rotation on the land used by the potato enterprise. As one may expect, there was a direct relationship between good cultural and good fertility practices with high yields. This was particularly evident in the use of commercial fertilizers and in the practice of fall irrigation. Table 10 shows the observed response

in yield associated with different applications of fertilizer and with the practice of fall irrigation. The most notable response to fertilizer, in yield per acre, occurred when fertilizer was applied at a rate of 251 to 350 pounds an acre. It was also evident that the practice of fall irrigation increased the yields in the following year. A more detailed breakdown of crop yields by variety and time of harvest is given in Tables A and B in the Appendix.

Table 10.- Average Yield per Acre of Potatoes, According to Different Fertility Practices, Edmonton and Irrigation Areas, 1962^a

Area and Variety		Particulars	Average Yield per Acre
			- tons -
Edmonton Area:			
Netted Gem	Harvest Sept. - Nov.	No fertilizer	4.7
Netted Gem	" " "	11-48-0 at 100-150 lbs.	5.2
Netted Gem	" " "	11-48-0 at 151-250 lbs.	5.2
Netted Gem	" " "	11-48-0 at 251-350 lbs.	9.2
Irrigation Area:			
Netted Gem	Harvest Sept. - Nov.	No fertilizer	b/ -
Netted Gem	" " "	11-48-0 at 100-150 lbs.	8.6
Netted Gem	" " "	11-48-0 at 151-250 lbs.	10.1
Netted Gem	" " "	11-48-0 at 251-350 lbs.	11.9
Netted Gem	Harvest Sept. - Nov.	16-48-0 at 100-150 lbs.	10.4
Netted Gem	" " "	16-48-0 at 151-250 lbs.	9.6
Netted Gem	" " "	16-48-0 at 251-350 lbs.	12.1
Netted Gem	Harvest Sept. - Nov.	11-48-0 at 100-150 lbs.	
	No fall irrigation		8.4
Netted Gem	Harvest Sept. - Nov.	11-48-0 at 100-150 lbs.	
	With fall irrigation		9.1

- a/ The yields shown in this table have been weighted by the acreages. For the acreage and number of fields in each sample, simple averages and standard deviation see Tables A and B of the appendix. All yields are in terms of field-run production.
- b/ Of all farms reporting Netted Gem acreage in the Irrigation area only 5 acres were reported with no application of fertilizer. The average yield per acre based upon this small acreage did not appear to be a reliable estimate to warrant printing in this table. See Table B, of the Appendix.

The larger enterprises had higher yields per acre (Table 8, line 1). It is difficult to attribute this relationship between size of enterprise and yields to any one factor. Variable costs per acre were somewhat higher for the larger than for the smaller enterprises (Table 7), which reflects, in part the greater use of fertilizers, sprays and tillage by the larger

enterprises. The potato enterprise, in the context of over-all farming operations, is generally a more important source of income for the operator of the large than for the operator of the small enterprise. Finally, many of the larger potato enterprises have developed in areas where local soil and climatic conditions are most suitable to potato production. These factors, plus the ease with which the product can be marketed, undoubtedly determine the extent to which a potato enterprise can be considered as successful.

Appendix

Table A.- Potato Yields per Acre; Weighted and Simple Averages; Acreage, Number of Fields and Standard Deviation, According to Time of Harvest and Fertility Practice, Edmonton Area, 1962^{a/}

Variety	Particulars	Total : acreage : in sample	Weighted : average : yield/acre	Number : of fields : in sample	Simple : average : yield/acre	Standard : deviation : tons/acre
		- tons -	- tons -	- tons -	- tons -	- tons/acre -
Warba	Harvest July - August	219	4.5	25	4.6	1.75
Netted Gem	Harvest Sept.- Nov.	1,364	6.2	55	6.1	2.40
Netted Gem	Harvest Sept.- Nov. No fertilizer	113	4.7	12	4.8	1.48
Netted Gem	" " " 11-48-0 at 100-150 lbs.	141	5.2	13	5.6	2.05
Netted Gem	" " " 11-48-0 at 151-250 lbs.	27	5.2	2	5.3	2.75
Netted Gem	" " " 11-48-0 at 251-350 lbs.	134	9.2	4	9.5	2.19

a/ The weighted average yield per acre was calculated by dividing the total production by the total acreage, within the particular sample of observation. The standard deviation was calculated from the simple, or non-weighted, average yield per acre. All yields are in terms of field-run production.

Table B.- Potato Yields per Acre; Weighted and Simple Averages; Acreage, Number of Fields and Standard Deviation, According to the Time of Harvest and Fertility Practice, Irrigation Area, 1962^{a/}

Variety	Particulars	Total : acreage : in sample	Weighted : average : yield/acre	Number : of fields : in sample	Simple : average : yield/acre	Standard : deviation : tons/acre
		- tons -	- tons -	- tons -	- tons -	- tons/acre -
Warba	Harvest July - August	111	6.6	9	5.9	1.68
Warba	" Sept.- Nov.	17	7.6	5	8.7	2.92
Cobbler	Harvest July - August	209	6.6	10	6.5	1.48
Cobbler	" Sept.- Nov.	290	6.7	5	5.6	2.23
Norland	Harvest July - August	208	9.8	7	9.1	1.96
Norland	" Sept.- Nov.	109	8.9	8	9.1	2.18
Pontiac	Harvest July - August	125	10.5	5	9.6	2.41
Pontiac	" Sept.- Nov.	150	11.2	17	9.5	2.91
Netted Gem	Harvest July - August	136	5.4	9	5.7	1.63
Netted Gem	" Sept.- Nov.	-	9.7	116	8.9	2.33
Netted Gem	Harvest Sept. - Nov. No fertilizer	5	9.5	4	8.3	1.92
Netted Gem	" " " 11-48-0 at 100-150 lbs.	521	8.6	22	7.2	1.89
Netted Gem	" " " 11-48-0 at 151-250 lbs.	784	10.1	18	9.3	2.57
Netted Gem	" " " 11-48-0 at 251-350 lbs.	167	11.9	3	11.4	0.95
Netted Gem	Harvest Sept. - Nov. 16-48-0 at 100-150 lbs.	313	10.4	6	9.8	2.05
Netted Gem	" " " 16-48-0 at 151-250 lbs.	458	9.6	9	9.2	1.61
Netted Gem	" " " 16-48-0 at 251-350 lbs.	440	12.1	5	12.1	1.45
Netted Gem	Harvest Sept. - Nov. 11-48-0 at 100-150 lbs. No fall irrigation	365	8.4	15	7.1	2.02
Netted Gem	Harvest Sept. - Nov. 11-48-0 at 100-150 lbs. With fall irrigation	156	9.1	7	7.6	1.52

a/ The weighted average yield per acre was calculated by dividing the total production by the total acreage, within the particular sample or observation. The standard deviation was calculated from the simple, or non-weighted, average yield per acre. All yields are in terms of field-run production.

